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ABSTRACT

This learning module, which is intended for use in in-service training for vocational rehabilitation counselors, deals with work design methods that are intended to improve client production and work quality. The following topics are discussed: work simplification, motion economy, the usefulness of jigs and cues in production, procedures for laying out the work floor, the value of process charts, and ways of solving layout problems. Also included are a list of references; worksheets on work station design, jigs and cues, and production methods; and two self-tests. (MN)

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REHABILITATION ASSOCIATE
TRAINING FOR EMPLOYED STAFF

PRODUCTION METHODS

(RA-38)

CE042765

MDC

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PRODUCTION METHODS

by

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REHABILITATION ASSOCIATE TRAINING
FOR EMPLOYED STAFF

MODULE: RA-38 Production Methods

DESCRIPTORS: *Work simplification, motion economy, jigs, cues, floor layout.*

OVERVIEW: As a supplement to the module on supervision, this module provides methods for work design to improve client production and quality of work.

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Objectives

Behavior

1. Describe a jig or cue to improve rate or quality of production.

2. Find errors in work area designs and correct them.

3. Find problems in work flow layouts and correct them.

Evaluation

1. The student will be given a description of a client and a task (or may choose one from his/her actual job setting).

2. The student will be given a description of a job (including a task analysis) and a description of the work area (or may choose one from his/her actual job setting). The student must find and correct one error. The checklist may be used.

3. The student will be given a description of a job and a work flow layout- (or may choose one from his/her actual job setting). The student must find and correct one problem. The corrected layout must:

    a. Minimize traffic distances
    b. Sequence traffic flow without bottlenecks or crossovers
    c. Be as simple as possible with no unnecessary steps
    d. permit piece work rates
    e. minimize hazards

Introduction

The roles and purposes of production in a rehabilitation facility have been discussed in the module " Production Supervision". Briefly, production serves these purposes:

a. It provides opportunities to train clients in vocational and work adjustment skills
b. It brings money into the agency
c. It helps clients to view themselves as adult, worthwhile people

WORK SIMPLIFICATION

The module on Production Supervision focused on the use of improved supervision to increase production. This module will emphasize improved design of tasks and work areas in accomplishing the same purpose.

This section will present some of the basic principles of motion economy and job layout. There will be no attempt to make you an expert in these areas. Some of the techniques are quite complicated. A shop which is developing major, long-term manufacturing should consider using an industrial engineer as a consultant in designing the work processes and floor layout.

What this section will do is teach you to look for some obvious ways to improve your work processes. Remember that the rehabilitative purpose of production may sometimes require you to sacrifice efficiency in order to provide necessary skill development. More often, however, efficient production goes hand-in-hand with skill development and work adjustment.

NOTE: Some of the following materials have been adapted or reprinted from "Production Improvement in a Rehabilitation Workshop". Any such materials will be noted "P.I.". This book, available from the Materials Development Center, is an excellent resource.

P.I. *

The definition of work simplification is the organized application of common sense by everyone to eliminate waste of any kind--of time, energy, materials, space, or equipment.

You don't have to be an engineer or expert to know that a workman taking 12 steps to get material is wasting both time and energy if the materials could be located closer...

Where can work simplification be applied in a workshop?

Work simplification can be started in any of the following places. They are listed in the usual order of attention:

1. Layout: The locations of raw materials, work station, and finished products in the plant

2. Materials Handling: Distances and equipment

3. Sequence: The order in which the steps or operations are performed

4. Work Methods: How the employee does his job, manner of performing the operation

5. Layout: The locations of materials, tools, equipment, and jigs in the work station

6. Equipment: Used in production

7. Product Design: The physical properties of the product: specifications, tolerances, appearance, and functional use.

8. Materials: Used in the product and as supplied to facilitate its production...

The use of labor saving machinery in workshops for the handicapped is sometimes opposed by those who think they are doing the client a favor. Nothing could be further from the truth. Antiquated, inefficient tools in a skilled workman's hands is sufficient in itself to handicap him. When handicapped clients are forced to use obsolete equipment, they are burdened with a double handicap--their own and the one imposed by the machinery (or lack of it).

In shops where prime manufacturing is carried on, design and use of the most suitable material is extremely important, since materials costs are two to four times greater than direct labor costs on the average...

P.I. **

Why Should Workshops be Efficient?

The tremendous production capacity of the United States has come from the efficiency with which its resources are used. This has generated the world's highest standard of living. Business is never ceasing in the attempts to improve the productivity of its operations. Workshops must strive for the same improvements or they will fail to provide a realistic work environment for their clients.

Workshop people often have to explain that a rehabilitation program in a workshop will likely be operated at a financial loss. That is, income from the sale of workshop products and income from subcontracts will be less than the cost of making the products and doing the contract work. There are good reasons for this loss. The handicapped clients require more learning time, supervision, space, and equipment, and administrative overhead than will a smaller group of non-handicapped persons producing the same quantity of products.

* pp. 7-9
** pp. 50-51

However, the notion that "workshops mean losses" has been misused so that wasteful and inefficient practices are sometimes explained away as the natural consequences of operating a workshop. Rehabilitation is used to cover up for managerial mistakes or low client wages or lack of concern for the cost of workshop operations. Instead of attempting to hold losses to a minimum, some workshops relax their concern for efficiency to the point of expecting or creating a loss in order to justify their existence. "After all," they say, "This is a workshop--not a business. We're concerned about people, not dollars." But sponsoring organizations and communities should no longer tolerate poor management of inefficient work practices. Nor should rehabilitation agencies accept evaluations of their clients' productivity when real work situations have not been provided.

When workshops have adopted the efficiency emphasis of business, they will find themsel es financially and psychologically better off. They will also find that their rehabilitation results will improve.

The obligation to be efficient--to eliminate waste of time, of space, and of materials--is owed to many people. You, as a member of the workshop's staff owe it to:

1. Yourself

   Your own pride of workmanship can only come from knowing that you've done a good job

2. Your workshop

   Your salary is paid because you can return more to the workshop than it gives to you. They rely on you to work efficiently and help others to do so.

3. Your Clients

   They need your help to learn good work habits

and efficient work methods. Give them less and you hurt their rehabilitation achievements.

4. Your Customers

They may not stay your customers if someone else figures out a more efficient way of doing their work.

5. Your Community

They support your services to people programs and have a right to expect efficient use of the monies given your shop for this purpose.

There are obviously reasons for having efficient production methods. How can efficiency be improved? This module discusses two methods: motion economy and floor layout.

MOTION ECONOMY

P.I. *

Extensive research has shown that the following principles of motion economy are applicable to all work movement:

In the general work place:

1. Eliminate unnecessary and disturbing noises and distractions
2. Materials and supplies should be delivered to the work place quickly and automatically, often by gravity.
3. Materials and supplies should be easily and automatically removed from the work place

In the individual work place:

4. Correct inadequate lighting
5. Eliminate hazards
6. Use paint colors to reduce eye strain and to

* pp. 45-46

7. Reduce large scale motions
8. Use tools and equipment designed to reduce human effort
9. Arrange work to permit an easy and natural rhythm

Using the simplest, smallest motions which make it possible to perform the work satisfactorily:

10. Gravity feed bins and containers should be used to deliver materials close to the point of use
11. A chair of the type and height to permit a good posture should be provided. Arrange so worker can alternately sit and stand.
12. Two or more tools should be combined, if possible
13. Motions are ranked from easiest (finger motions only) to hardest (body motions)
14. Sliding materials rather than lifting and carrying them
15. Momentum should be employed to assist the worker. It should be reduced to a minimum if it must be overcome by muscular effort. Arrange tools, equipment, materials, and machine controls so motion paths to them are within the range of the shortest movements of the arms.
16. Perform work within reach of the hands with the elbows held close to the body
17. The hands should be relieved of all work that can be done more advantageously by a jig, fixture, or a foot operated device

Using hand and arm motions in a fixed, rhythmical sequence:

18. Tools and materials are arranged to match the sequence of work steps
19. Tools and materials are pre-positioned
20. The two hands should begin as well as complete their motions at the same time
21. Movements follow a continuous, curved path than zigzag or straight line motions involving sudden and sharp changes in direction

22. Alternate lead hand or hand used to hold tool
23. The two hands should not be idle at the same time except during rest periods
24. Motions should apply power or force at the best time with the least effort
25. Ballistic movements are faster, easier, and more accurate than restricted (fixation) or "controlled" movements
26. Movements of the hands and arms should be in opposite and symmetrical directions and should be made simultaneously
27. Hands should not be used for holding material on which an operation is being performed
28. Rhythm is essential to the smooth and automatic performance of an operation

Hence, motion economy is a way of working that requires the least effort and strain in accomplishing a job. It includes ways and means of obtaining the highest output for the least input.

P.I. *

When improving a work method, the following steps should be taken in the order given:

1. *Eliminate* the work because:

   Its purpose has long disappeared

   It is perfomed for operator convenience

   A different sequence would make it unnecessary

   Better equipment would make it unnecessary

2. *Combine* the work through:

   A change in work place or equipment design

   A change in sequence

* pp. 52-54

A change in raw material or end product design

Evidence that the work load at a certain work place is too low

Cross training to increase the skill of operators

3. *Rearrange* the sequence of work to:

Ease or shorten any of the work

Reduce material handling or walking

Save floor space or reduce in-process time

Take advantage of better equipment or skills

4. *Improve* the work by:

Pre-position materials and tools

Better equipment

Use gravity feed hoppers and drop delivery chutes

Let both hands do useful work

Use jigs and fixtures instead of hand for holding work

Training operators in better work patterns

Better services or supervision

There are eight basic hand motions or actions which are involved in most manual tasks. The following suggestions for each of them may be helpful in making improvements:

1. Select

Can the layout eliminate searching for items?
Can tools and materials be standardized?
Are parts and materials properly labeled?
Can parts and materials be pre-positioned
Can color be used to facilitate selection?
Is lighting satisfactory?
Are parts and materials mixed?
Could bins, trays, etc. facilitate or eliminate selection?

2. Group

Is it possible to grasp more than one at a time?
Can objects be slid instead of carried?
Will a lip on a bin simplify grasp of small parts?
Can tools or parts be pre-positioned for easy grasp?
Can a vaccuum, magnet, rubber finger, etc., be used?
Is article transferred from one hand to another?

3. Transport

Can the motion be eliminated?
Is the distance travelled necessary?
Are the proper means used: foot, hand, pliers, conveyor?
Are the lowest classification of body members used?
Can a chute or conveyor be used?
Could items be accumulated and moved in larger groups?
Is transport slowed for a close fit positioning at the end of it.
Are preceding and following operations properly related?
Can abrupt changes in motion be eliminated?
Is the fastest body member used for weight moved?
Can any body movements be eliminated?
Can arm movements be made simultaneously symmetrically and in opposite directions?
Can the object be slid instead of carried?
Are eye movements coordinated with hand motions?

4. Hold

Can a vise, vacuum, hook, rack, fixture be used?
Can adhesive or friction be used?
Can a stop be used to eliminate hold?
Could arm rests reduce fatigue?

5. Release

Can drop delivery be used?
Can the release be made in transit?
Can a careful release be eliminated?
Can an ejector be used?
Are materials bins properly designed and located?
At the end of release is the hand in most advantageous position for next motion?

6. Pre-position

Can object be pre-positioned in transit?
Can the tool be balanced in usable position?
Can article be designed so as many sides are alike as possible?
Can magazine or clip feed be used?
Can a rotating fixture be used?

7. Position

Can tolerances be increased?
Is positioning necessary?
Can square edges be eliminated?
Can a guide, stop, locating pin, recess, swing bracket be used?
Can arm rests steady the hands and reduce positioning time?
Has the object been grasped for easiest positioning?
Can a foot operated device be used?

8. Inspect

Can illumination be increased?
Can gauges be used?
Can mechanical inspection replace visual?
Can pressure, vibration or hardness test be used?

These lists provide a tremendous number of suggestions. However, they may not all be entirely clear. Hopefully, the lists can serve as a checklist to look through when you are evaluating your production methods. In other words, you can take a method and ask each of the above questions. With practice you will find that possible improvements wil become obvious.

For example, a workshop may have a packaging task in which a required number of nuts, bolts, and washers of two different sizes are put in a plastic bag, stapled and boxed. The current process is as follows:

1. A supervisor puts boxes of 1,000 of each item at the workplace.
2. The worker picks up a bag from the box.
3. The worker opens the bag by holding the closed end with her left hand and pushing the other end open with her right.
4. The worker switches hands so that the left hand holds the bag open.
5. The worker picks one item out of each box and puts it into the bag.
6. The worker staples the bag.
7. The worker drops the bag into a large box on the floor.
8. When all 1,000 bags are completed, the worker signals the supervisor.
9. The supervisor picks up the box and carries it to a storage area in a corner of the room.
10. The supervisor brings 1,000 more of each item.

Look through the 28 principles. Decide which are violated. Write down the number of the violation and a possible solution for each. For example, principle #2 recommends that materials be delivered automatically. In this case, the supervisor brings the materials 1,000 at a time. You would write:

#2-Build a box storage at each table that will hold 12 boxes of each item. At least 5 other principles (and perhaps 7 or 8) are violated. Find

at least 3 of them.

Here are some ideas:
Principles:

#3-A dolly should be placed under the empty box so that it can be pushed instead of carried

#10-Items should be placed in bins with gravity feed trays rather than be left in boxes

#14-With items in trays, clients should slide items off edge of table into bag instead of picking them up

#16-All bins should be within reach of worker's forearms so they do not move upper arms

#17-A jig should hold the bag

#19-Bins should be kept in a standardized position

#20-With a jig for two bags and two bins for each item, the worker could fill two bags at one time

Because of #26, the bins should be arranged so that movement of each hand is from outside bins to center bins

#27-See #17

(SEE SELF-TEST #1)

WORKSHEET: *Do Production Methods Worksheet #1-Work Station Design*

JIGS AND CUES

The principles of motion economy point out the usefulness of jigs and cues in production. Jigs and cues are at least as important in rehabilitation facilities as they are in ordinary industry. Clients with poor motor skills, poor coordination, or insufficient strength can profit greatly from jigs. Clients who have difficulty making dis-

criminations because of learning difficulties or sensory deficits may be helped by extra cues.

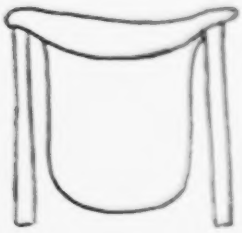
A *jig* is a fixture which is used to perform an operation on an item, such as holding, positioning, or bending. One example of a jig is a wood block which stops a length of wood so that each piece is cut to the same length without the need for measuring?

A *cue* is an extra stimulus which makes a discrimination easier. One example is a tray which has 12 compartments; this permits a client who cannot count to box items by the dozens. Another example is color-coding of electrical parts.

Again, let's use the example of packaging nuts, bolts, and washers. Assume the client must put in the package these items: 3-$\frac{1}{8}$" O.D.X$\frac{3}{4}$" bolts, 3 matching washers, and 3 matching nuts, 6-$\frac{1}{4}$"O.D. X 1$\frac{1}{2}$" bolts, 6 matching washers and 6 matching nuts. The client can count but makes many errors. The client also mixes up which quantities are needed for each size and drops pieces.

Describe one jig which might improve rate or quality of performing this task. Here are some possibilities:

a. To hold the bag, use two upright pins or dowels.



b. To hold the bag, use a french-fry bagger like the ones at fast-food places. The bag can sit on a tray with the mouth around a stationary bagger.

c. To prevent spilling, use a chute or funnel. The french-fry bagger could fill this purpose too.

Describe one cue which might improve rate or quality of this packaging task.

a. Show a picture on each bin of the correct number of items to be taken.

b. Color code each bin. In front of the bins, put wood blocks with holes drilled in them. There should be three ⅜" holes and three holes the correct size for the matching washers and nuts. There should be six ¼" holes and six holes of the correct sizes for the matching washers and nuts. The holes should be slightly oversized to permit easy removal of items and should be color-coded to match the items. The blocks should be loose so that the client can turn them upside down after she has filled them.

WORKSHEET: *Do Production Methods Worksheet #2- Jigs and Cues*

Do Production Methods Worksheet #3

Laying out the Work Floor

Improved design of the work area and the task can improve productivity. In the same way improved layout can improve production.

A work floor which requires long walks for materials, has traffic patterns that cross each other, and has employees out of sight of the supervisor is inefficient and possibly unsafe. Production will be improved if the same job can be done with closer storage of materials, traffic patterns

that flow from one work operation directly to the next, and an area open to the supervisor's sight.

P.I. *

Good layout requires:

Placing the *proper equipment*

In the *right place*

To permit processing the item by the *best method*

Through the *shortest possible distance*

In the *shortest possible time*

Danger signals of poor layout:

1. Congestion of materials or in process assemblies
2. Excessive work in progress
3. Long transportation
4. Production bottlenecks
5. Excessive material handling by skills operators
6. Long production cycles
7. Idle equipment

Types of layouts:

1. Fixed position: Material stays in one place, tools, machinery, and men are brought to it
2. Process: All operations of the same type are grouped together
3. Product: Machinery and work stations arranged in a sequence as needed for the processing or assembly of a product

Considerations in layout designs:

1. Weight and volume of material to be handled
2. Storage requirements: Warehouse, at work station, surge piles
3. Number of different handlings and available methods

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* pp. 18 & 19

4. Sequence and distances of material
5. Necessary aisle width to accommodate material handling equipment pallets, hand trucks, etc.
6. Access for sampling and inspection
7. Visual supervisory control
8. Locations of rest rooms, drinking water, lunch rooms, etc.
9. Locations of utilities, compressed air, lighting, heating, ventilating, air conditioning, etc.
10. Relationships to supporting services: maintenance, timekeeping, shipping, and receiving, etc.
11. Adaptability and flexibility to changes, expansions
12. Future growth needs
13. Cost of changes

How can layout problems be avoided and work flow improved? Layout design can be very complicated. A facility which is laying out its entire floor may wish outside consultation. However, when designing work stations for a new contract, a facility may profit by planning its layout carefully.

(SEE SELF-TEST #2)

The first step in layout is use of a process chart. This will show what possible bottlenecks can occur.

P.I. •

The process chart is the most widely used work simplification form. It is prepared after the flow diagram has determined the material handling pattern and work station locations. The process chart's wide usage is a result of its ability to describe the work of a person on his job (man process chart), the changes in an item as it goes through manufacturing (material process chart), (form process chart), to mention a few.

Symbols and definitions have been developed for use on process charts. These include:

A "doing" *operation*: when an object is changed physically or chemically, or is

assembled or disassembled.

A "made ready" or "put away" *operation*: when an object is arranged or prepared for another operation, inspection, storage, or transportation

A *transportation*: when an object is moved except when the move is part of an operation or is made by a worker at his work station

An *inspection*: when an object is examined for identification or checked for quality or quantity

A *delay*: when conditions do not permit or require immediate performance of the next operation or inspection or storage

A *storage*: when an object is kept and protected against unauthorized removal.

The steps in the preparation of a process chart includes:

1. Identify the area or problem which is to be studied
2. Choose the subject to be followed: a person, a material, a product, or a form
3. Determine and describe the starting and stopping point in the manufacturing or processing process.
4. Write a brief description of each step--avoid the use of "and" to keep from combining two steps. Use action verbs in each phrase.
5. Assign a symbol to each step.
6. Record the time taken and distance travelled, if applicable.
7. Record the quantity produced, if applicable
8. Note where problems exist and jot down brief ideas for improvements
9. Summarize the operations, moves, inspections, storages, and delays
10. Consult with employees before preparing the final chart.

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flow diagram may then be drawn. If the task is already being done at the agency, the current flow diagram would be drawn first. Then a process chart of the current process would be prepared. An improved process chart would be developed and a new flow program drawn from it.

A flow diagram is simply a scale drawing of the work floor with arrows drawn on it to show movement.

P.I. *

The flow diagram should be the first device used in analyzing the overall performances of a job, a department, or a section within a workshop; or of the entire workshop. It is literally a road map which traces the flow of materials or movements of persons in the production process. Using it helps to pinpoint:

1. Long moves between operations
2. Small volume items, or low production work areas located on the most direct line-of-flow
3. Backtracking
4. Large column items or high production work areas on long routes or through out-of-the-way corners.
5. Storage areas which interfere with material flow.

Material handling and the travel of people predominate the flow diagram considerations.

The flow diagram is a sketch of the work area, preferable to scale. It shows the path taken and the distances travelled by the materials or person being studied.

On page of the *Instructional Activities Manual Supplement* there is a sample flow diagram for the operation of packaging bulk co-fee into smaller packages. Using the blank process chart

* p. 12

also found in the activities manual, prepare a chart for the flow of coffee based on this chart. When you finish, compare it to the sample chart. After you have completed the chart and compared it to the sample, return to this page and continue reading.

You may also chart the process a worker goes through in performing the task. This usually requires watching the worker in action and cannot be done directly from a flow chart. A worker process chart is very similar to a task analysis. Ordinarily, the process chart is less detailed than a task analysis and is intended to show what the major steps are. Following are two examples of worker process charts for the same task of coffee packaging. Process chart 1 is somewhat less detailed than process chart 2. Either chart is correct if it can help you decide how the process can be improved.

Solving Layout Problems

Using a flow chart and process chart may help you solve layout problems. Remember the following principles for good layout:

a. Use proper equipment
b. Minimize traffic distances
c. Avoid bottlenecks caused by unnecessary delays
d. Avoid bottlenecks caused by individual differences in production rates. If production requires a sequence of operations performed by different people, use surge piles (storage areas between steps) so that a slow worker does not slow production of other workers.
e. Use as few operations as possible to produce the item
f. Minimize cross-traffic
g. Where possible, design operations so that individual piecework rates can be measured
h. Allow all workers to be seen by supervisor at one time, if possible
i. Minimize safety hazards

The activities manual contains both a flow and process chart for a task of packaging tablecloths. The tablecloths come in three shapes--rectangular, round, and oval. Each shape comes in two sizes. Each tablecloth must be put in a plastic bag; the correct picture/description sheet must be enclosed (face out) and the bag must be sealed.

Find at least one error in the layout and correct it. Use the forms at the end of the text to draw a corrected flow diagram and prepare a new materials process chart using the blank forms provided. Then compare them to the sample improved layout.

There is no correct answer. Your layout may be better than the sample.

Some of the problems with the current method include these:

1. There is excessive cross-traffic around the tablecloth storage area. This may be hazardous and is certainly distracting.
2. The distance from the separator to storage is too long.
3. Folders must first walk to get the cloths. Then, after folding, they must walk again to get bags and pictures. That involves too much wasted motion.
4. Folders must decide which picture is correct. For some clients, that decision will not always be accurate. Also, pieces of pictures may get mixed up. This will cause delays in picking the correct picture.
5. Filled packs must be transferred from piles to dollies. That kind of work (bending and lifting) is time-consuming and physically demanding.

The sample of improved method reduces the cross-traffic. It also is likely to improve accuracy, as each client works with only one size and shape of tablecloth. Because filled packs are placed directly into dollies, a bending and lifting operation is eliminated.

Some problems still exist in the sample improved method. Separating and sealing operations may be bottlenecks. Transporting of tablecloths to folding tables still involves long distances. There is still some cross-traffic. Perhaps your proposed improved method solves these problems.

To get better at layout, practice is necessary. As an assignment, layout a work area for a job you work with at your facility. Prepare a flow diagram and a process chart for the present and the improved meth-

If you wish to learn more about motion economy and floor layout, read Motion and Time Study by Ralph Barnes. Motion economy, improved layout, and bet-

ter supervision tactics will provide better efficiency and habilitative training.

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PRODUCTION METHODS: Worksheet #1

WORK STATION DESIGN

For the following work station, find as many errors as possible. For each error, tell how to correct it. The task is "separating coupons." The facility has a contract to separate coupons by company and price. The task analysis as follows:

1. Pick up coupon.
2. Find company name
3. Place coupon in the box for that company

Later, when boxes are filled, they are separated by piece, using the following task analysis:

1. Pick up coupon
2. Find price
3. Place coupon in the box for that price

The work area is a large table. In the middle of the table are the boxes for company or price (whichever is being separated at the time). A client picks up a handful of coupons from a large carton and, one at a time, finds the correct box, walks to it, and puts the coupon in it.

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PRODUCTION METHODS: Worksheet #2

JIGS AND CUES

For the following situation, describe two possible jigs and two possible cues which may improve rate or accuracy.

Mabel makes cable harnesses for washing machines. Each harness has four color-coded wires which are passed through a clamp. The clamp must then be screwed tight. The final ½" of each wire must then be stripped, and each wire must be screwed to the correct terminal on a plug.

Mabel has limited use of her right hand. In addition, she frequently attaches wires to the wrong terminals or does not tighten the cable clamp adequately.

PRODUCTION METHODS: Worksheet #3

For the following situation, prepare a supervision program to correct the problem:

John is assigned to package rubber bands. He must get a bag, put in rubber bands, weigh the bag, and correct the amount in the bag if necessary. He then staples the bag. Although he is accurate, his work rate is very low for these reasons:

a. Because of limited use of his left hand, John has difficulty holding the bag open while filling it. He also has trouble positioning the bag and stapling it.

b. John spends a lot of time looking carefully at the scale to assure that the weight is in the correct range.

c. After completing one or two bags, John stops, rubs his clothes rapidly, shakes his head back and forth, and mumbles for 30 seconds to 1 minute before continuing to work.

1. Design a work station. Show where all materials will be. Use the checklist to help you.

2. Describe any jigs or cues you will use.

3. Describe any special supervision activities you will try.

SELF-TEST #1

1. What is meant by "work simplification"? In what areas of the workshop can it be applied?

2. What is meant by motor economy and what are 5 examples of ways of improving motion economy?

3. What is work method and what are 3 ways of improving work method?

SELF-TEST #2

1. What is a jig? What is a cue? Provide examples of the use of jigs and cues? In what ways might additional ones be helpful in your workshop?

2. List 4 ways of improving work floor layout?